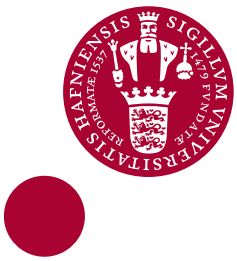

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Price reactions when consumers are concerned about pro-social reputation*

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October 2014

Abstract

In this paper, we propose a reputation-signalling model of demand for consumer goods containing pro-social characteristics such as a 'fair trade' or 'organic' certification. We show that reputation signalling can reverse price reactions resembling the crowding-out of pre-existing motives for pro-social behavior seen in situations of volunteering and charitable giving. Finally, using a unique combination of questionnaire and purchase panel data, we present evidence of such reputation-driven reversal of price reactions in the Danish market for organic milk.

Keywords: Net-crowding out; Reversed price reactions; Pro-social reputation; reputation signalling; Consumer goods

JEL-codes: D03, D11, D12, D64, D82, and D51

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1. Introduction

Economists normally predict that monetary incentives induce a positive response because the rewarded behavior becomes more attractive. If, for example, the price of a product falls, we expect demand for the product to increase. However, recent studies have found that incentives can be counterproductive in settings like charitable giving and volunteering. It seems that in these settings, incentives can crowd-out pre-existing motives for pro-social behavior. In this paper, we ask if similar crowding effects could arise for everyday consumption products with 'pro-social' characteristics such as 'fair trade' or 'organic' certification, and we investigate if consumers who are concerned about reputation exhibit such behavior in the Danish market for organic milk.

Bénabou and Tirole (2006) suggest that one reason for pro-social behavior like giving blood or volunteering work is that it sends a signal that the person undertaking the behavior is a pro-social type. For people concerned about having a pro-social reputation (or image), this becomes an extra reason for volunteering. But when the pro-social behavior is rewarded, this signal is weakened because others or the retrospectively observing self[1] may think that the behavior was motivated by the incentive rather than pro-social preferences. In such situations, the reduction in reputation signalling that payment causes counteracts the increase in monetary incentives, and if the reputation reduction is strong enough, the net effect may be negative. This may explain the net negative effect of incentives seen in many empirical studies on charitable giving and volunteer work[2].

It has also become clear that consumers of everyday market products are willing to pay for pro-social characteristics such as fair trade, animal welfare and environmental friendliness (see, e.g. Bjørner et al., 2004; Hicks and Schnier, 2008; and Bougherara and Combris, 2009). Ariely et al. (2008) and Bénabou and Tirole (2011) suggest that one reason why consumers are willing to pay a price premium is that buying "good" rather than "bad" variants of a product generates pro-social reputation because this - like volunteering - sends the signal that the consumer has pro-social

[1] Reputation signals may be sent to others, but Bénabou and Tirole (2006) also suggest that signalling to oneself may be an important motive. The idea is that behavior that sends a clear pro-social signal also makes it easier to identify one's own underlying motives when evaluated in retrospect. The importance of retrospective self-signalling has support in a substantial psychological literature.

[2] The introduction of monetary incentives has been found to affect blood and charitable donations negatively (Titmuss', 1970; Meier, 2007; Mellstrom and Johannesson, 2008), reduce previously unpaid work (Heyman and Ariely, 2004; Ariely et al., 2009; Leuven et al., 2010, Gneezy and Rustichini, 2000b), and reduce parents timely pick-up of their children from a day-care centre (Gneezy and Rustichini, 2000a).

preferences[3]. This signal could be sent to other shoppers, the cashier or more likely to significant others who are able to observe the chosen good like family and friends. The signal could also be sent to a retrospectively observing future self to bolster a positive perception of herself as a prosocial individual. The idea is that underlying motives and considerations cannot be observed by others and are difficult to recall accurately by a future self. In contrast, the actual good and purchase price are more salient to others and a future self.[4] Ariely et al. (2008) and Bénabou and Tirole (2011) have pointed out that one implication of this could be that demand from consumers concerned about reputation is distorted towards more salient products (and away from less salient, but perhaps more socially beneficial products). The question we address in this paper is: What happens to the demand for such a salient 'good' product if the price difference to 'bad' variants of the same product becomes small or negative?

When the price of the 'good' variant of a product falls, it becomes less expensive to demonstrate pro-socialness by buying the product and for this reason the product becomes more attractive. However, in much the same way as when giving blood is rewarded, the signal sent by buying the product may be weakened. When the 'good' product variant becomes inexpensive, it becomes attractive for consumers with lower pro-social preferences. When this happens, others (including the retrospectively observing consumer herself) may think that a purchase of the 'good' product variant was motivated not by high pro-social preferences, but by the small price difference between the two product variants. For consumers that value reputation, this loss of signalling value counteracts the effect of the price reduction, in effect crowding-out prior reputational motives for buying. If the reputation loss is strong enough to outweigh the monetary gain from the lower price, they may find it less attractive to purchase the 'good' product variant than before the price fall. Thus, if 'reputation' is an important motive for buying pro-social good characteristics, we might see

[3] The idea that consumers can obtain reputation from purchasing a product sold on a market is by no means new. Tucker (1957) argued that consumers' personalities can be defined through product use, while Sirgy (1982) emphasized the importance of packaging, advertising, and price in addition to the physical characteristics of the product in generating image. Others have studied the signalling effects surrounding design innovation, fashion cycles, and luxury goods (early examples are Ireland, 1992; Pesendorfer, 1995; and Bagwell and Bernheim, 1996).

[4] In the following we will often just refer to 'signalling' or 'signalling to others' for brevity. We would like to stress that when doing this we also mean to imply signalling to future selves. While the evidence we present in the following does not shed light on the relative importance of self-signalling, our feeling is that self-signalling may in fact be important in many consumer good markets including the one we study.

reversal of reactions to changes in market prices in much the same way as the introduction of incentives sometimes has resulted in reduced charitable donations.

In this paper, we combine a Bénabou and Tirole (2006) reputation-signalling model and a characteristics model[5] of consumer's choice between products to formally explain how pro-social consumer good characteristics may generate a pro-social reputation that some consumers are willing to pay for.[6] This allows us to understand more precisely how different types of consumers react to changing prices when reputation is important for consumer choices, while it also allows us to predict under what market conditions we may expect to see reversal of reactions to price discounts for the good variant to, or below, the level of the 'bad' variant price. Specifically, we show that reversal of price reactions is possible when outside options, such as close substitutes for the product are readily available. We then use a unique Danish consumer panel that combines detailed purchase data on milk with questionnaire data, which allows us to identify consumers who are concerned about their pro-social reputation when buying organic milk. We find evidence of reverse price reactions within this group. The evidence also suggests that this is net-crowding out[7] driven by reputation signalling, since consumers less concerned about their pro-social reputation do not exhibit this reaction. We also find evidence against possible alternative explanations such as differences in shopping time, health and quality concerns, or a general dislike of price discounts among consumers who are concerned about their reputation. Our data also suggest that the proportion of reputation-concerned consumers is substantial.

[5] The characteristics model was first developed by Gorman (1980) and Lancaster (1966) and further developed by Muellbauer (1974) and Rosen (1974). The model assumes that goods are bundles of characteristics, and that consumers derive utility from these characteristics rather than from the goods themselves. The goods are seen as linear combinations of characteristics, and a given characteristic (e.g. the organic attribute) may appear in different goods.

[6] Note that while Bénabou and Tirole's (2006) model is easily adapted to explaining how changing relative prices affects image in a market situation, most other explanations of pro-social crowding-out focus on the fundamental shift from the non-monetary to the monetary situation caused by the introduction of incentives. This is the case for authors suggesting that introducing incentives changes the decision environment from a social to a monetary frame (e.g., Gneezy and Rustichini, 2000b; Heyman and Ariely, 2004); affects preferences directly (e.g., Deci, 1975; Frey, 1997); destroys trust (e.g., Falk and Kosfeld, 2006; Fehr and Falk, 2002; Fehr and List, 2004); and affects agent's perception of preferences (e.g., Seabright, 2009; Bénabou and Tirole, 2003; Sliwka, 2007; Ellingsen and Johannesson, 2008; Schnedler, 2011).

[7] We use the term net-crowding (see, e.g. Bénabou and Tirole's (2006)) to denote the situation where thecrowding-out of prior reputational motives completely outweighs the positive initial price effect of monetary incentives. This situation has also been termed 'overcrowding' (e.g. Perino et al.,2012) and 'strong crowding out' (e.g. Bowles and Hwang, 2008)

While there are a number of theoretical and empirical studies of the interaction between incentives and pro-social/pro-environmental behavior, we are not aware of any other papers which develop and study a formal model of consumer choice incorporating signalling of pro-social preferences, or any existing empirical evidence of such pro-social signal crowding-out. We incorporate signalling in the same way as in Bénabou and Tirole's (2006) model of volunteering and find that net-crowding out (a reverse price reaction) is possible, although there are important differences. Volunteering effort to increase a pro-social outcome signals pro-social preferences *devoid* of monetary valuation. This is why the introduction of incentives causes a qualitative shift in what volunteering signals, from a signal that clearly indicates pro-social preferences, to a diluted signal possibly indicating greed instead. In contrast, when one *buys* pro-social attributes which are incorporated in a traded product, this is by construction a signal of the consumer's monetary valuation of the pro-social outcome. The purchase therefore sends a clear signal of the consumer's pro-social preferences *relative* to greed. Therefore, changing the price changes the strength of this signal, but not its interpretation. We show that one implication of this is that reductions in the price of the good product variant do *not* cause consumers to substitute the 'good' with the 'bad' variant. Demand for 'good' product variants may become unresponsive to price reductions because reputation signalling is reduced, but this does not cause reversal of price reactions (net -crowding) when the best alternative is to buy the 'bad' product variant with the associated 'bad' reputation. However, perverse price reactions become possible (and may be substantial) when the best alternative is *not* to buy the product at all. In this case, consumers can avoid the reputation stigma of buying the bad product variant by opting out of the market. Thus, we find that net-crowding out is possible in product markets. However, this is not driven by consumers reversing their choice of product variant and the signal they are sending (the type of mechanism at play in the volunteering situation), but instead by consumers avoiding signalling altogether by completely opting out of the choice situation. One important implication of this is that while signalling effects may cause reversal of demand reactions to a price reduction in a good variant, the effect on pro-social outcomes may be small or even positive. This is the case if reputation-concerned consumers switch to a 'good' variant of a close substitute with a larger price difference to its bad counterpart. This may have important policy implications. For example, general subsidies for 'good' variants of products (like the general support schemes for organic production seen in some countries) will not always be as efficient as differentiated support schemes where some 'good' product variants are subsidized while others are not. In addition to the specific results we present, our model may be a

useful framework for investigating other dimensions of consumer reactions when reputation is important (e.g. how consumers might react to the introduction of new products with different private and pro-social characteristics).

Several recent experimental studies (Griskevicius et al., 2010; Sexton and Sexton, 2014; Teyssier et al., 2012; Friedrichsen and Engelmann, 2013) show that prosocial reputation plays key role when consumers choose products containing prosocial components such as "green" or "fair trade" certification. The study which is closest to ours is the field experiment by Perino et al. (2013), which finds evidence of motivation crowding in consumer goods markets. They give food purchasers in a supermarket three treatments. Information about the carbon footprint induces a shift towards 'good' variants as does a 'neutral' lower price of these variants without information. However, the combination of a lower price and information in the form of a government 'carbon' motivated subsidy induces less shifting than either treatment alone. This suggests that the consumer's perception of being 'controlled' by a government subsidy crowds-out the intrinsic motivation activated by the carbon footprint information. In our paper, we present empirical evidence for crowding-out which we argue is caused by pro-social signalling independent of framing effects.

The remainder of the paper is organized as follows. In Section 2, propose a reputation-signalling model of demand for consumer goods containing pro-social characteristics. In Section 3, we develop model predictions. Section 4 presents empirical evidence from a Danish consumer panel which suggests that reputation-concerned consumers have a backward bending demand curve for organic milk and other behavior consistent with the model developed in sections 2 and 3. Section 5 presents some policy implications, while section 6 concludes the paper.

2. A consumption model with pro-social reputation

We consider a consumer contemplating whether to buy the 'good' or the 'bad' variant of a consumer product. This could be a consumer choosing between, e.g. an organic or a conventional liter of milk; or between a 'free trade' variant of a pound of coffee versus a normal one. We assume that both variants of the product give the same private utility u (in the form of taste, nutrition, etc.), while only the 'good' variant contains the 'pro-social' characteristic, e.g. in the form of a less

environmentally damaging production process or higher payment to third world farmers[8]. Let v^g be the intrinsic utility the consumer receives from purchasing this pro-social characteristic which is assumed to be greater than or equal to zero. Let p^g and p^b be the price of the good and bad product variants respectively and let u and v^g be measured in monetary equivalents. Then the total utility that the consumer derives from consuming the two product variants becomes:

$$\begin{aligned} U^g &= u + v^g - p^g \\ U^b &= u \quad\quad - p^b \end{aligned} \tag{1}$$

This is a simple linear characteristics model of a consumer's choice between two product variants with two characteristics (a private and a pro-social characteristic). We now add to this a third characteristic: the effect of consuming the product variant on the consumer's 'reputation'. Let r^g and r^b denote this effect when purchasing the good and bad variant respectively. Letting v^r denote the consumer's utility value of reputation (also measured in monetary equivalents), the total utility of the two available consumption opportunities becomes:

$$\begin{aligned} U^g &= u + v^g - p^g + v^r r^g \\ U^b &= u \quad\quad - p^b + v^r r^b \end{aligned} \tag{2}$$

Given (2) and observing that a consumer purchases the good variant and the prices he is faced with allows an observer[9] to deduce that:

[8] Labeling schemes or a credible producer often make such pro-social characteristics salient both to the consumer buying the product, and to others with whom the consumer interacts.

[9] In this paper, we refer to reputation and signalling to others that the consumer interacts with. However, as noted by Bénabou and Tirole (2006), the observer may also be the consumer, while the signal may be intended as a salient reminder to the consumer of the type of person he/she is.

$$
\begin{gathered}
U^g > U^b \\
\Leftrightarrow \\
v^g + v^r r > p^g - p^b \\
\text{where } r = r^g - r^b
\end{gathered}
\tag{3}
$$

Following Bénabou and Tirole (2006), reputation does not derive from the purchase itself, but from what can be deduced about the consumer's preferences from observing the purchase. We assume that reputation is derived from the expected value of v^g. Thus, seeing the purchase of a 'good' variant of the product allows the observer (which could be the retrospectively recalling consumer herself) to conclude something about the consumer's preferences for the pro-social characteristic relative to money (i.e. his minimum willingness to pay for the pro-social characteristic is greater than or equal to the observed price difference). Seeing a 'bad' purchase allows the observer to conclude the opposite (i.e. that his maximum willingness to pay for the pro-social characteristic is less than or equal to the observed price difference).

If there is *no* purchase, we will assume that the observer cannot conclude anything about the consumer's social preferences. This is an important assumption that drives results in the following. Bénabou and Tirole (2006) model an agent being asked to contribute to a pro-social activity. In their case saying no is an active opt-out which is a salient signal to the elicitor, other observers and future selves. In our case what makes saying 'no' to the good product variant salient is buying the bad product variant. When one buys the bad variant of the product it becomes clear that the consumer was in the market for the product in question and so must have considered the good variant and decided that the prosocial characteristic was *not* worth the added cost. If the consumer doesn't buy the bad variant, the de facto 'no' to the good variant becomes less salient to an observer. The de facto 'no' also becomes much less informative since a likely reason for not buying the good variant is that the consumer was not in the market for the product in question. An observer (including a future self) cannot know which variant would have been chosen if the consumer had been in the market for the product and so cannot conclude anything about the consumer's willingness to pay for the pro-social characteristic.

While the intrinsic utility (v^g) derived from purchasing the pro-social characteristic varies across consumers, we assume for now that v^r has the same value for all consumers. This allows the creation of a parsimonious model which can be used to study and understand the basics of how

reputation affects market reactions to price changes. We allow for heterogeneous reputation concerns in section 4.

Seeing a 'good' purchase, an observer can deduce that $v^g > p^g - p^b - v^r r$. Therefore, the reputation derived from purchasing each of the two variants becomes:

$$\begin{aligned} r^g(\bar{v}^g) &= E\left[v^g \,\middle|\, v^g \geq \bar{v}^g \right] \\ r^b(\bar{v}^g) &= E\left[v^g \,\middle|\, v^g < \bar{v}^g \right] \end{aligned} \tag{4}$$

$$\text{where } \bar{v}^g = p^g - p^b - v^r r \tag{5}$$

It follows that $r^g > r^b$ and that $dr^g / d\bar{v}^g > 0$ and $dr^b / d\bar{v}^g > 0$. Thus, the sign of $dr / d\bar{v}^g$ is ambiguous depending on which of the two derivatives is the largest numerically. Intuitively, a reduction in the price of the good variant initially causes consumers of the bad variant with v^g values just below $\bar{v}^g$ to buy the good variant instead. Since the new buyers of the good variant have lower v^g values than those already buying, this reduces the expected v^g value of good variant buyers, and thus the reputational 'honor' reaped from buying the good product falls. But since those moving away from the bad variant have greater v^g than those continuing to buy, the expected value of v^g for consumers of the bad variant also falls, and the stigma associated with purchasing the bad variant increases. Depending on which effect dominates, the initial shift of close to indifferent consumers from the bad to the good variant can have either a positive or a negative effect on the *net* reputation gain a consumer receives from buying the good rather than the bad variant. In the following, we investigate both situations.

3. Demand reactions when consumers are concerned about pro-social reputation

In this section, we investigate how a fall in the price of the good product variant influences demand. Initially we consider how consumers react when there is no outside option, such as a close substitute, to the product in question so that consumers end up choosing one or the other variant of the product. We then consider reactions when there is an outside option so that consumers may choose to opt out of the choice between the good and bad product variants and purchase the close substitute instead. Finally, in the last sub-section, we allow for heterogeneity in reputation concerns.

Our focus is on how a change in the price of the good product variant affects demand when consumption has important effects on reputation. To investigate how a change in price (p^g) affects demand, we first consider how this change affects $\bar{v}^g$. Implicit differentiation of (5) gives:

$$\frac{d\bar{v}^g}{dp^g} = \frac{1}{1+v^r dr / d\bar{v}^g} \tag{6}$$

Now consider *N* consumers who have decided to buy the product and therefore choose between the good and the bad variant. The number of consumers who choose the good product variant (D^g) is a function of $\bar{v}^g$. Intuitively, as $\bar{v}^g$ increases, the proportion of consumers buying the good variant ($v^g \geq \bar{v}^g$) falls. Formally we have:

$$D^g(\bar{v}^g) = N \int_{v^g=\bar{v}^g}^{\infty} f(v^g) dv^g \tag{7}$$

Where $f(.)$ is the distribution function for v^g and *N* is the total number of consumers in the market for the product. Conditional on total demand for the product , the change in demand for the good variant resulting from a change in its price is $\frac{dD^g}{dp^g} = \frac{dD^g}{d\bar{v}^g}\frac{d\bar{v}^g}{dp^g}$ and the slope of the classical inverse demand function (*s*) becomes:

$$s = \left(\frac{dD^g}{d\bar{v}^g}\frac{d\bar{v}^g}{dp^g}\right)^{-1} = \underbrace{\left(dD^g / d\bar{v}^g\right)^{-1}}_{<0}\underbrace{\left(1+v^r\, dr/d\bar{v}^g\right)}_{?} \tag{8}$$

Clearly $\frac{dD^g}{d\bar{v}^g} < 0$ and if there is no reputation effect (i.e. $dr / d\bar{v}^g = 0$), we have the classical situation with a downward sloping inverse demand curve (where $s < 0$). If, however, there is a reputation effect from a decrease in p^g, it may be positive ($dr / d\bar{v}^g < 0$), or negative ($dr / d\bar{v}^g > 0$) as we have discussed above and we consider these cases in turn. We first look at the two cases in a world without an outside option (where we can condition on total demand *N*), and then investigate how the presence of an outside option changes these results.

Reinforcing reputation effects

A small price decrease induces the marginal consumer of the bad variant (with v^g values equal to or just below $\bar{v}^g$) to shift from the bad to the good variant. If this increases the net-reputation gained from buying the good variant instead of the bad variant (i.e. if $dr/d\bar{v}^g < 0$), the initial price effect is reinforced by making it even more attractive to buy the good variant. Looking at (8) we see that when $-1 < v^r dr/d\bar{v}^g < 0$ the negative slope of the demand curve is moderated, hence increasing the demand response to a given price change. If the reinforcing reputation effect is large enough (if $v^r dr/d\bar{v}^g \leq -1$), the slope of the inverse demand function may become zero or positive. One such situation is illustrated in figure 1. The part of the figure between points A and B is characterized by an upward sloping inverse demand curve caused by a reinforcing reputation effect (where $v^r dr/d\bar{v}^g < -1$).

Initially, a price reduction from a high price above p_A^g will result in a normal movement down the negatively sloping demand curve until p_A^g is reached after which the demand curve becomes upward sloping. Intuitively, when the curve becomes upward sloping, the reinforcing effect of reputation becomes so strong that it is self-sustaining. An initial small price reduction from the equilibrium point A attracts the marginal consumer to the good variant. The reputation effect of this addition makes it attractive for the next consumer to switch without any additional price reduction and so on. It is easy to verify that equilibria on the negatively sloping parts of the curve are locally stable, while equilibria on the positively sloping part are not.[10] When B is reached, the self-sustaining reputation effect stops. Although B is locally stable at the corresponding equilibrium

[10] If a consumer with a preference parameter marginally (dv^g) lower than $\bar{v}^g$ accidently shifts to the good variant, the effect on his utility of this shift would be $dU = \bar{v}^g - dv^g - p^g + p^b + v^r(r - \frac{dr}{d\bar{v}^g} dv^g)$. Since by definition $\bar{v}^g - p^g + p^b + v^r r = 0$ we have that $dU = -(1 + v^r \frac{dr}{d\bar{v}^g})dv^g$. When $(1 + v^r dr/d\bar{v}^g) > 0$ (the downward sloping part of the curve) the consumer experiences a utility loss from the change and reverts, implying a locally stable equilibrium. When $(1 + v^r dr/d\bar{v}^g) < 0$ (the upward sloping part of the curve) the consumer experiences a utility gain and remains, implying an unstable equilibrium.

price, the price (p_A^g) is lower and so consumer shifting continues to the new equilibrium A1. However, should the price again rise from an equilibrium at or below A1, we have a series of locally stable equilibria along the curve from A1 to B. If the price increases from B, we again see a dramatic market shift to B1, as indicated in figure 1.

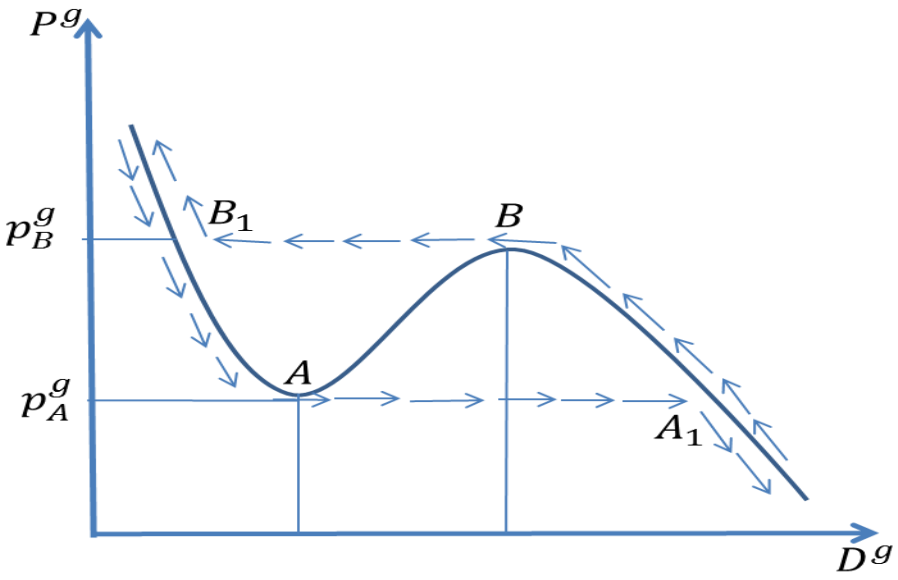

Figure 1: Inverse demand curve with reinforcing reputation effects

Thus, if the reinforcing reputation effects are large enough, it may cause dramatic and asymmetric reactions to price changes as the market shifts between locally stable equilibria.

Counteracting reputation effects without an outside option

If we are to see net-crowding of the type shown by Bénabou and Tirole (2006), it must be when a price decrease, which initially makes the good variant more attractive, has a counteracting effect on the reputation gained from buying the good variant, i.e. when $dr/d\bar{v}^g > 0$. Such a reputation effect counteracts the initial price effect by making it less desirable to buy the good product variant. However, it is easy to see that net-crowding is not possible in the corresponding market situation where there is no outside option.

Looking at equation (8) again, we see that a counteracting reputation effect ($dr/d\bar{v}^g > 0$) causes the negative slope of the demand curve to become steeper, thereby reducing the demand response to a given price change. A numerically large reputation effect can cause the slope to be become very steep, but it can never become backward bending. Intuitively, there must be some remaining

demand shift to the good variant in order for the counteracting reputation effect to be activated. Thus, consumers switching from the good to the bad variant because of reputation effects can mediate the initial price effect, but can never reverse it.

This is in contrast to the volunteering situation analysed by Bénabou and Tirole (2006), where net-crowding is possible. In volunteering situations, people make an *effort* to achieve a combination of a pro-social outcome and possibly a monetary incentive for volunteering. Thus, volunteering may be an indicator of both a good and a bad dimension of reputation (pro-socialness and greed). In this case, an incentive increase changes the quality of the signal making it a relatively better indicator of greed than of pro-socialness. If greed is very detrimental to reputation, then attracting the marginal greedy (and less pro-social) volunteer can damage reputation more than repelling the marginal pro-social (and less greedy) volunteer. If this is the case, attracting a small number of greedy volunteers may damage reputation more than repelling a large number of the least pro-social volunteers. This twist in the quality of what is signaled by volunteering may therefore result in monetary incentives being more than crowded-out by signalling effects in the volunteering situation.

Counteracting reputation effects with an outside option

Sometimes, however, the best alternative to buying the good product variant is *not* to buy the bad product variant, but rather to buy something else, i.e. to opt out of the given product market altogether. We will now see that opting out of the market by switching to another product may, in some situations, result in the complete crowding-out of the original price effect similar to Bénabou and Tirole (2006).

Let U_a denote the utility of the outside option, e.g. buying the best alternative product, so that (combining with (2)) consumers face three alternatives from which they choose:

$$\begin{aligned} U^g &= u + v^g - p^g + v^r r^g \\ U^b &= u \qquad - p^b + v^r r^b \\ U_a & \end{aligned} \tag{9}$$

With this new outside option available, a consumer purchases the good variant of the product only if this generates more utility than both the bad variant and the alternative product, i.e. if:

$$U^g > U^b \text{ and } U^g > U_a \tag{10}$$

Defining $\bar{U}_a$ as the value of $U_a = U^g$ where a consumer is indifferent about buying the good variant or the alternative product, we have by definition that:

$$\bar{U}^a = u + v^g - p^g + v^r r^g \tag{11}$$

It follows that demand for the good variant depends on both $\bar{U}_a$ and $\bar{v}^g$. Let $w(v^g, U_a)$ denote the joint distribution function describing consumer values for these two parameters, then in the same way as for equation (7), the demand for the good product variant must be:

$$D^g(\bar{v}^g, \bar{U}_a) = N \int_{v^g=\bar{v}^g}^{\infty} \left(\int_{U_a=-\infty}^{\bar{U}_a} w(v^g, U_a) dU_a \right) dv^g \tag{12}$$

We can now investigate how demand reacts to a price change when consumers in addition to buying the bad variant, also have the possibility of opting out by e.g. buying a substitute product. Differentiating (12) gives:

$$\frac{dD^g}{dp^g} = \frac{dD^g}{d\bar{v}^g}\frac{d\bar{v}^g}{dp^g} + \frac{dD^g}{d\bar{U}_a}\frac{d\bar{U}_a}{dp^g} \tag{13}$$

Where the first element is the effect of consumers switching to the bad variant (corresponding to equation (8)), and second element captures the switch to the alternative product. Equation (11) implies that:

$$\frac{d\bar{U}_a}{dp^g} = -1 + v^r \frac{dr^g}{dp^g} \tag{14}$$

Inserting (14) and the definition of s in equation (8) into (13) gives:

$$\frac{dD^g}{dp^g} = s + \frac{dD^g}{d\bar{U}_a}\left(v^r \frac{dr^g}{dp^g} - 1\right) \tag{15}$$

Thus the slope of the new inverse demand curve $\tilde{s}$ is:

$$\tilde{s} = \left(\frac{dD^g}{dp^g}\right)^{-1} = \left(\frac{1}{s} + \frac{dD^g}{d\bar{U}_a}\left(v^r \frac{dr^g}{dp^g} - 1\right)\right)^{-1} \tag{16}$$

$$<0 \quad \geq 0 \quad \underbrace{\qquad}_{\geq 0}$$

We are investigating the possible crowding-out of the initial effect of a reduction in p^g and so we consider a counteracting reputation effect ($dr / d\bar{v}^g > 0$) so that $s = \frac{dD^g}{d\bar{v}^g}\frac{d\bar{v}^g}{dp^g} < 0$. This gives us the indicated signs in (16). From equation (16) we see that if there is no outside option (i.e. $\frac{dD^g}{d\bar{U}_a} = 0$), the slope reduces to *s*. This is the slope that we derived in equation (8) for the situation without an outside option. If there is an outside option (i.e. if $\frac{dD^g}{d\bar{U}_a} > 0$), the resulting slope is augmented.

If consumers are sufficiently concerned about reputation (i.e. if v^r is large enough), the negative reputation effect of a good variant price decrease is large enough to outweigh the price effect (i.e. if $v^r \frac{dr^g}{dp^g} > 1$), the last parenthesis in (16) becomes positive. In this case, net utility from consuming the good variant falls for all consumers and therefor the outside option becomes relatively more attractive to all consumers. If the initial utility difference to the outside option is small for many consumers originally buying the good variant then the out flux of such consumers can be greater than the original influx of consumers from the bad variant. Thus a small influx of consumers from the bad variant, who do not find the outside option very attractive, may drive a larger out flux of consumers from the good variant out who originally found the outside option almost as attractive as the good variant.

An example of a situation where this could occur would be if the outside option is a product with the same pro-social characteristic (and signalling value) and similar in other characteristics. If most consumers find the difference in other characteristics small, they would only slightly prefer one to the other and a small reduction of net utility of the good variant because of reduced signalling value could drive many consumers to the alternative product. If a few consumers of the bad variant find the differences between these products significant then they would not be attracted to the alternative

market when the good variant price is reduced. Instead they shift to the good variant and cause the reduction in signalling value[11].

When the only alternative is the 'bad' product variant, the slope of the good variant demand curve (s) is always negative no matter how large the counteracting reputation effect is. This changes when a switch to an outside option is possible. Introducing the possibility of an outside option makes it possible for the this slope to pass through $-\infty$ and become positive. As the price decreases, the denominator in (15) $(1+s\frac{dD^g}{d\bar{U}_a}(\frac{dr^g}{dp^g}-1))>0$ passes through zero at p_A^g and becomes negative (corresponding to the slope becoming vertical and the demand curve becoming backward bending at prices below p_A^g and above p_B^g). From p_B^g and down the demand curve again has the normal negative slope in the illustrated example.

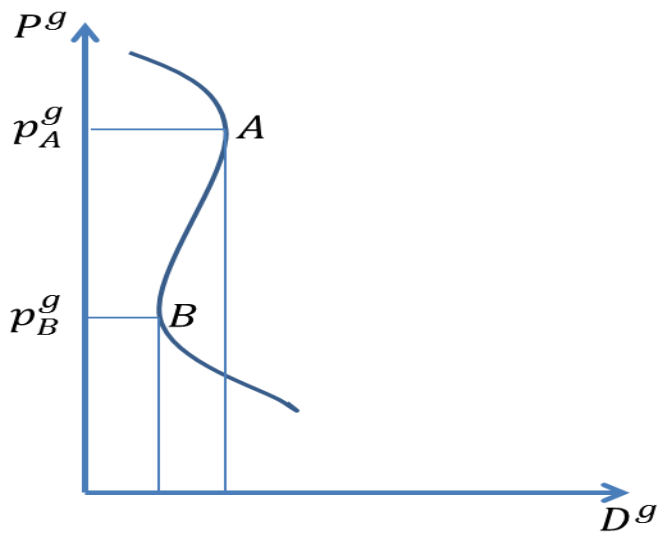

Figure 2: Inverse demand curve with counteracting reputation effects

[11] It is easy to construct examples where out flux to the outside option is greater than in flux from the bad variant in this way e.g. by specifying $U^a = U^g - e$ where e is a non-positive random variable. A reverse price reaction with a backward bending demand curve results when v^r is sufficiently large and the distribution of e has sufficient mass close to zero.

Introducing heterogeneous reputation concerns

In this section we investigate demand reactions to a price reduction in the good variant in the same way as the previous sections, except that we let concern for reputation be heterogeneous across consumers. We do this by using numerical simulations of the model developed above for a population of 1,000 consumers. Each consumer chooses among the three alternatives in (9) the one that maximizes her utility after being assigned the four utility function parameters: u, v^g, v^r and U_a. The parameter u is normalized to zero, U_a values are uniformly distributed and half the consumers are assigned $v^g = 0$, while the remaining are assigned positive v^g values drawn from a uniform distribution (see the appendix table A1 for details and the ranges of the distributions assumed). Finally, we apply two different parameterizations of v^r which are discussed below.

Reputation values r^g and r^b are calculated as the mean of v^g values for consumers choosing to buy the good and bad product variants respectively. For a given set of prices (p^g, p^b), the model finds the equilibrium distribution of consumers across the three markets (where all consumers' choices maximize their utility given the reputation values generated by the distribution). When simulating this model for a population of consumers with *homogenous* reputation concerns ($v^r = 1$) we can reproduce the qualitative results of the previous sub-sections. Table 1 presents results for a simulation where consumers have heterogeneous reputation concern with half the consumers are assigned $v^r = 0$ (no concern for reputation), while the remaining are assigned positive v^r values drawn from a uniform distribution ($v^r \in]0,1]$). Thus, half of the consumers are unconcerned about reputation, while the other half is concerned to varying degrees – some only slightly concerned, while others are very concerned.

In the first row of table 1, results are simulated for a population where reputation concern (v^r) and intrinsic pro-social utility (v^g) are perfectly correlated[12], in the second row v^r and v^g are uncorrelated.

The first column presents results for a situation with no outside option, while the second column has the corresponding results when there is an outside option. For each case, we first present the percentage change in aggregate good variant demand. Below the aggregated changes, we present the corresponding percentage change in demand from the most and the least reputation-concerned consumers (with v^r values over and under 0.5 respectively).

In the first row (where pro-social preferences and reputation concern are correlated), we see that aggregated market reactions are moderated compared to the bottom row in table 1. We see that consumers with the most reputation concern react in the way predicted by our theoretical results for reputation-concerned consumers (illustrated in the bottom row of table 1). The price reduction reduces the reputation value of buying the good variant by so much that consumers who are highly concerned about reputation find that the price reduction makes the good variant less rather than more attractive to buy.

Table 1: Percentage change in demand for the good product variant when its price falls with heterogeneous reputation concerns*

			With outside option	
	No outside option			
Correlated Pro-social and reputation concern	Aggregate effect +47%		Aggregate effect +63%	
	Most concerned +1%	Least concerned: +109%	Most concerned: -4%	Least concerned: +150%
Uncorrelated Pro-social and reputation concern	Aggregate effect +39%		Aggregate effect +91%	
	Most concerned +34%	Least concerned: +64%	Most concerned: +88%	Least concerned: +107%

[12] Thus, in this population, 50% of the consumers have $v^g = v^r = 0$, while the remaining 50% have positive and perfectly correlated values for both these utility parameters (i.e. $v^r > 0$ and $v^g > 0$).

**Good variant price falls by 10%, Most concerned:* $v^r > .5$ *, Least concerned:* $v^r < .5$

When there is no outside option, the demand of reputation-concerned consumers is virtually unaffected because there is no good alternative to the less attractive good variant. When there is an outside option, they opt out and switch to the outside option. The least concerned consumers, on the other hand, act as predicted by standard neoclassical theory since the reduced reputation value of the good variant is of little importance to them. When there is no outside option, the total demand increases as consumers of the bad variant are attracted to the good variant by the price reduction. When there is an outside option, even more consumers are attracted from this market. When aggregating, these more 'neo-classical' consumers moderate the reactions of the most reputation-concerned consumers.

In the bottom row of table 1, results are simulated for a similar population with heterogeneous reputation concern, but now reputation concern (v^r) and intrinsic pro-social utility (v^g) are *un*correlated. We see that when consumers' intrinsic pro-social and reputation concern are not correlated, the crowding-out effects seen for reputation-concerned consumers in the top row disappear, allowing for a large positive aggregated reaction to decreasing prices. What happens is that the counteracting reputation effect is replaced by a reinforcing reputation effect when intrinsic and reputation concerns are uncorrelated. When reputation and intrinsic concern are uncorrelated, a substantial proportion of consumers have a low reputation concern and high pro-social preferences. Among these, the marginal buyers of the good product variant have relatively high v^g values. Since they are not concerned about reputation, they are attracted to the good variant by a price reduction. This will tend to *increase* the mean value of v^g for purchasers of the good variant because most consumers on this market initially are reputation-concerned consumers with on average lower intrinsic v^g values. If the positive reputation effect of this influx of reputation unconcerned consumers with high v^g values outweighs the negative reputation effect of reputation-concerned (low v^g value) consumers attracted from the bad product variant, the net reputation effect of the price reduction becomes positive and the reputation effect reinforcing. When this happens, more consumers are attracted to the good product variant from the bad product variant (increasing the demand effect when there is no substitution in the first column) and from the alternative product (further increasing the demand effect when there is substitution in the second column).

To conclude, the introduction of heterogeneity in reputation concern complicates interactions without essentially changing them. If pro-social preferences and reputation concern are uncorrelated, counteracting reputation effects derived from reducing the price of a good variant are unlikely. However, if they are positively correlated, we may have counteracting reputation effects that significantly moderate the demand reactions of consumers who are concerned about reputation when there is no outside option. This may result in net-crowding out within this consumer segment. Our simulation also makes it clear that such reactions from reputation-concerned consumers may be outweighed by positive reactions from less concerned consumers. Thus, even when aggregate market reactions appear 'neoclassical,' a significant segment of consumers may be experiencing reputation motivation crowding-out or even net-crowding out.

In the next section, we present empirical evidence of net-crowding out for reputation-concerned consumers from the Danish organic milk market characterized by close substitutes.

4. Reverse price reactions and signaling in the Danish organic milk market

In Denmark, organic milk has a market share of about 30% (Organic Denmark, 2012), which is dominated by the three types of milk (skimmed, mini and semi-skimmed milk) (Danish Agriculture and Food Council, 2012).[13] These three types of milk are close substitutes in the usual sense of the word with the main difference between them being the fat content. While organic milk probably is perceived by many consumers as having private benefits such as health and taste, studies confirm that most consumers also perceive organic products as containing pro-social characteristics such as being less harmful to animal welfare and the environment[14]. Thus, the Danish milk market is characterized by 'good' (organic) and 'bad' (conventional) variants of three close substitutes providing the kind of outside option witch might cause reverse reactions to price reductions.

In Denmark, both organic and conventional milk of all three types are sold in all major super markets and food stores. Special stores for organic products are practically non-existent and

[13] In Denmark, fresh milk of the three variants of reduced fat milk (skimmed, mini and semi-skimmed milk) dominates the retail market. Whole milk and cream are typically used for cooking and are not close substitutes for reduced fat milk used for direct consumption.

[14] See, for instance, Thøgersen and Ölander (2003, 2006), Yiridoe et al. (2005), Hughner et al. (2007), Halkier and holm (2008), Lund and Jensen (2008), and Andersen (2010) for studies on pro-social motives of buying organic milk.

typically organic and conventional milk variants are placed close together on refrigerated shelves in supermarkets.[15] Thus, consumers of milk for direct consumption are typically offered all three types of milk in both a conventional and an organic variant at the supermarket or food store where they usually buy milk in such a way that they can easily compare the prices. Thus, it is not difficult for reputation-concerned consumers to ascertain the price difference between good and bad variants of the type of milk they usually buy as well as for close substitutes. If signalling and counteracting reputation effects are active, this is the type of market where such signalling effects may generate reverse price reactions in the way discussed above.

We obtained purchase data from a consumer panel managed by GfK PanelServices Denmark (GfK). The GfK panel consists of about 2,700 consumers who, for each shopping trip, record which store chain they visit, the day and time of day of the trip, and the price and quantity of all products purchased, typically differentiated at close to bar code level including whether or not the product is organic. Consumers also answer questionnaires with a large number of questions relating to socio-demographics and media habits etc. In 2007 and 2008, surveys were completed by the main shoppers and they were asked about their knowledge of and attitudes towards organic food (organic attitude surveys).[16]

We investigate milk purchasing behavior of the subset of 263 consumers in the GfK-panel who were members of the panel during 2007 and 2008 and who only bought organic milk for direct consumption (skimmed, mini and semi-skimmed) during this period (i.e. these consumers did not at any time buy conventional milk of these types during these two years) [17]. We use a repeated question from the two organic attitude surveys to categorize respondents as either being the 'most reputation-concerned' or the 'least reputation-concerned' consumers. Consumers who agree or strongly agree to the statement "It is important for me to set a good example by buying organic products" are categorized as the 'most reputation-concerned', while the remaining are assigned to

[15] This contrasts with other countries, for instance Germany, where most organic products are sold at special stores which only sell organic products, while organic products in supermarkets are often presented in a special organic section.

[16] The questionnaire was issued as part of the ICROFS III project CONCEPTS (for details see Andersen, 2009). A detailed description of the collection process and the structure of the GfK dataset can be found in Andersen (2006).

[17] Out of the 263 consumers, 81.84% appear in both 2007 and 2008, while the remaining 6.26% and 11.90% appear only in 2007 and 2008 respectively. Descriptive statistics are presented in Appendix table A2.

the group of consumers who are the 'least reputation-concerned'. Using these criteria, 57% of consumers in our sample who only buy organic milk are categorized as the 'most reputation-concerned'.

The quantity of each type of milk purchased in each week during these two years is reported by each consumer in our subset. Consumers also report the purchase price of the milk they buy. Using these reports from all 2,700 consumers in the panel, we calculate the prices of the six different types of milk that the consumers face in the store where they bought their milk as the average price for that type of milk reported by the consumers for that week in that store[18]. Typically, organic milk prices in a given store are substantially higher than the price of the corresponding conventional milk variant and do not change much. However, once in a while, organic milk is put on discount and sometimes the discounted price is lowered to, or even below, the price of conventional milk. This happens in 2.17% of the weekly purchase observations where our sub-sample purchase skimmed milk, and in 0.52% and 3.10% of the observations where they buy mini, and semi-skimmed milk respectively. It is these events where the organic milk price drops to the conventional level (on average a drop of 18% compared to the price the week before) that we use to identify reverse price reactions among reputation-concerned consumers who never buy conventional milk.

Table 2: Percentage change in total purchased volume of organic milk during price discount weeks compared to the previous week

Aggregated market effect	
3%	
Most concerned	Least concerned
-6%	12%

Price discount week refers to weeks when the organic price drops to, or below, the conventional price. Sum of purchased quantities of milk in all price discount weeks compared with the corresponding sum of purchase quantities for the same consumers in the weeks preceding the price discount. See appendix table A3 for details.

We see that aggregate demand for the discounted organic milk increases by 3% compared to the week before. However, the *most* reputation-concerned consumers *reduce* demand by 6%, while

[18] Consumers report their expenditure on the product and the purchased quantity and the price is calculated from these reports. Stores typically change prices once a week and announce them in local free newspapers circulated once a week.

consumers with the *least* reputation concern *increase* demand by 12%. This pattern of demand reactions is similar to those simulated for the most and least reputation-concerned consumers when there are close substitutes in column two of table 1 above. Thus, it looks as though consumers with the most reputation-concerned react to the discount by buying less (i.e. exhibiting a reverse price reaction), while the least reputation-concerned react by increasing demand.

To obtain a complete picture of how consumers behave and to control for possible confounding effects, we estimate multinomial logit (MNL) choice models[19] of consumers' milk demand incorporating prices of substitutes in the shop where the purchase is made and controlling for consumer characteristics, etc. Since our sub-sample only buys organic milk, each consumer *i* chooses the organic alternative which gives the highest utility among four relevant alternatives $j \in \{skim,\ mini,\ semi, nobuy\}$ each week $t \in \{1,\ldots,T\}$. We assume the following utility outcomes for each alternative she considers:

$$\begin{aligned} U_i^{skim} &= \beta_i^{skim} + \beta_p p_{it}^{skim} + \beta_d d_{it}^{skim} + \varepsilon_{it}^{skim} \\ U_i^{mini} &= \beta_i^{mini} + \beta_p p_{it}^{mini} + \beta_d d_{it}^{mini} + \varepsilon_{it}^{mini} \\ U_i^{skim} &= \beta_i^{skim} + \beta_p p_{it}^{skim} + \beta_d d_{it}^{skim} + \varepsilon_{it}^{skim} \\ U_i^{nobuy} &= 0 \qquad\qquad\qquad\qquad + \varepsilon_{it}^{nobuy} \end{aligned} \tag{17}$$

Here p_{it}^j is the price of organic milk of type *j* in the store where consumer *i* bought milk in week *t*, and d_{it}^j is a dummy indicating whether the price is less than, or equal to, the conventional price of the same type of milk in that store in that week. The core of this system is a standard model of consumers' choice where the utility value of alternative specific characteristics is β_i^j, the consumer's utility value of money is β_p, and ε_{ijt} is an error term assumed to be extreme value distributed. We have added the consumers' utility value of a price discount to the conventional price level, β_d, to capture reactions to the reputation effect of such a price discount. Such price discounts are large and so this parameter may also capture non-linearity in reactions to price

[19] See McFadden (1974), Greene (2008) and Train (2009).

reductions. In addition to the core parameters, the model includes a large number of socio-demographic and attitude variables as controls (see appendix table A4).

The *general MNL* model we estimate includes a 'no purchase' option, which accounts for consumers reacting to a price change both by switching to/from another type of milk, or by buying more/less milk than they usually do. This model therefore captures both the effect of price changes on choice among milk types conditional on a purchase of milk being made, and also changes in total purchased milk volume. Table 3 summarizes the main estimation results for the consumers with the most reputation concern, and for consumers with the least reputation concern (see appendix table A4 for the complete set of estimated model parameters).

Table 3: Estimation Results for General MNL model of consumer's milk demand

	Estimated parameters (standard deviation)
Most concerned about reputation	
Price	-0.078***
	(0.012)
Price discount dummy	-0.244***
	(0.07)
Least concerned about reputation	
Price	-0.103***
	(0.013)
Price discount dummy	0.359***
	(0.058)
Number of consumers¤	263
Number of observations	119244
Log likelihood	-92859.297***
Pseudo R	0.028

****, **, and * represents significance level at 1%, 5%, and 10% respectively*

The model is highly significant and explains about 3% of the data variation, which is normal for such models of household level purchase data. We see that both groups of consumers react to a price reduction by increasing demand (as indicated by the negative highly significant effect of a price increase on the purchase probability). In contrast, when the price is reduced to the conventional milk price, the two groups' reactions differ. The marginal effect of this occurring on the most reputation-concerned consumers is a reduction in demand (as indicated by the negative

highly significant parameter to the dummy indicating this event), while the least reputation-concerned consumers react by increasing demand (as indicated by the positive highly significant parameter).

In table 4 below we present own price elasticity implied by the estimated model and the implied percentage change in demand which results from a price reduction to the conventional price level (a reduction of 18% corresponding to the average reduction seen in our data). This effect includes both the pure price effect, and the added effect of a price discount to the conventional level captured by the discount dummy. We see that while both groups of consumers react to prices in almost the same way (an own price elasticity of -0.5 and -0.7), their reactions to a price reduction to the conventional level differ substantially. The most reputation-concerned exhibit a reverse price reaction by reducing demand by 11%. In contrast, the least concerned increase their demand by 60%. When comparing with the raw data tabulation in table 2, we see that the modeled demand reactions to a discount to the conventional price have the same signs, but are substantially greater in magnitude. This is because the modeled effects are calculated holding the prices of other types of milk constant, while stores often discount several types of milk at the same time. Thus, the effects of actual discounts to the conventional price in table 2 are often moderated by corresponding discounts on the other types of milk in the same store[20]. Our estimation allows us to control for this revealing that the underlying behavioral differences are substantially greater than they seem from looking at the raw data in table 2.

Table 4: Elasticity and demand effects of price discounts to the conventional price level.

	General model
Most concerned about reputation:	
Own price elasticity	-0.53
Demand effect of price discount to conventional price	-11%
Least concerned about reputation:	
Own price elasticity	-0.70
Demand effect of price discount to conventional price	60%

The presented elasticities and demand effects of a price discount to the conventional price are calculated for the mean price and price discount to conventional price across all consumers, milk types and weeks in our dataset.

[20] For example 29%, 40%, and 17% of the price discount events for skimmed, mini, and semi-skimmed organic milk in our data are events where there are also price discount events for at least one other organic milk type in the same store.

We have run a number of alternative specifications of the presented model with varying combinations of control variables, alternative specifications of the price discount effect, alternative price assumptions for no purchase choices and other stress tests. All give the same pattern of results as reported in table 3 (see Appendix table A4 for details). We have also run a number of variations of more common *conditional* MNL models (without the no purchase option), which capture switches to other types of milk, but *not* changes in total milk volume (see appendix table A5), all of which show the same pattern of consumer reactions.[21] Finally, we have run several data mining models where we include all core variables in all equations without restrictions to check whether the results are driven by model constraints. Again we find the same pattern of price and price discount effects as reported in table 3 and clearly reject constraints implying positive/negative demand effects of own/cross price discounts for the *most* reputation-concerned while accepting the reverse set of constraints. At the same time, we clearly reject constraints implying negative/positive demand effects of own/cross price discounts for the *least* reputation-concerned while accepting the reverse set of constraints (see Appendix tables A6-A10 for details). Given the consistency of these results from different model variations, it seems well founded to conclude that consumers that we categorize as the most reputation-concerned *do* exhibit reverse demand reactions to price discounts to the 'bad' variant price level, while consumers who we categorize as the least reputation-concerned do not.

The observed difference in reactions to price discounts to the conventional level between the most reputation-concerned consumers and the least concerned is what we would expect to see if reputation signalling is important for the latter group of consumers. However, there could be other explanations for the observed behavior. One possible alternative explanation could be that the observed difference is caused by systematic differences in the time of day that consumers in the two groups buy their milk. Price discounts may result in the discounted good being sold out at the end of the day more often than when there is no discount. If this is the case, late shoppers intending to buy discounted milk might be rationed more often when there is a discount. If consumers we categorize as reputation-concerned systematically shop later in the day than less reputation-concerned, this

[21] The conditional MNL-model used in many demand studies conditions on a good being purchased. Therefore, the results reflect consumers' substitution reactions conditional on the total quantity demanded by the consumer, but do not capture whether consumers react by changing total demand. The general MNL-model also captures changes in total milk demand.

might explain the observed difference. We can check this since panel participants report the time of day of each shopping trip. We find no significant difference between the distributions of shopping times of the two groups (see figure 3 below with the distributions). The Kolmogorov–Smirnov test of equality of the two distributions accepts the hypothesis with p-value of 0.223 (the standard t-test also supports this results with p-value of 0.613).

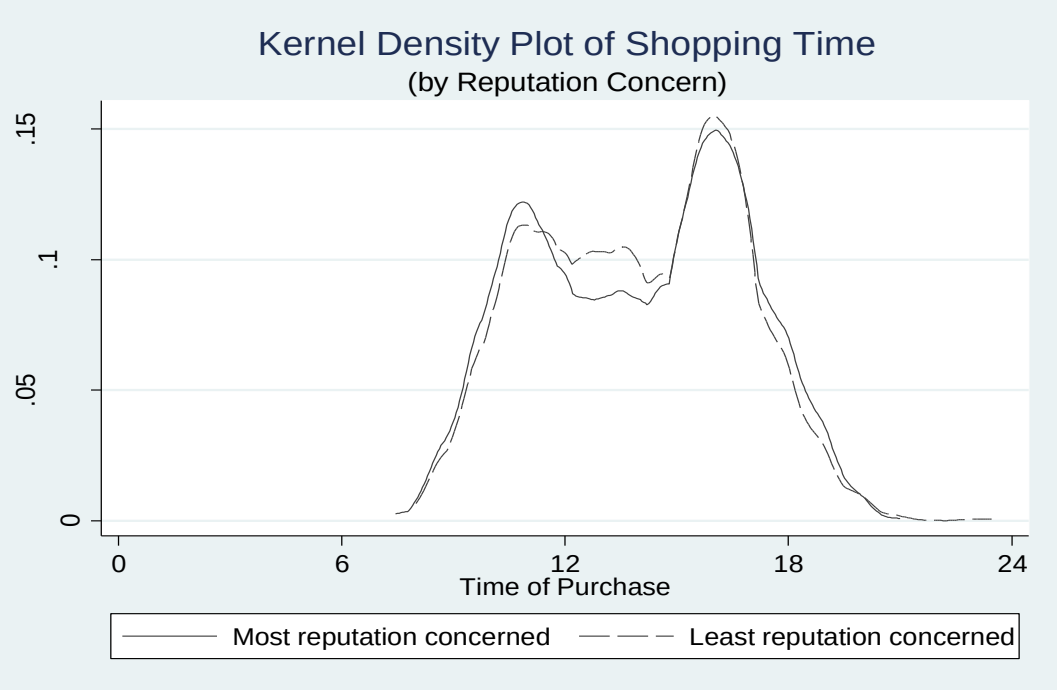

Figure 3: Shopping time by Reputation Concern in discount weeks

We have also estimated our model after restricting to purchase events early in the day (where the likelihood of rationing is low) and get less significant but essentially the same estimation results: the most reputation-concerned consumers react negatively to price discounts while least reputation-concerned react positively (in Appendix A11 we present estimation results when restricting to purchases before 13:00 eliminating over 50% of the purchase observations).

Another possible explanation could be that consumers interpret the discounted price as a signal that the discounted milk is of lower quality than usual (eg., closer to expiration date and therefor possibly of lower quality and/or less healthy). If consumers that are more reputation-concerned are also more concerned about quality or health, this could be why they react negatively to price discounts on milk. There is no objective reason why this should happen since the price discount

events we identify are store wide whole weak promotion discounts for organics. However since shops do sometimes discount milk close to expiration date to get it sold, we cannot rule out that some consumers perceive promotion discounts in this way. We are, however, able to check if this can explain the difference in observed price reactions since our panel surveys have questions on how important quality and health motives are for buying organic milk. Though these motives are in fact positively correlated with reputation concern in our sample (with correlation coefficients of 0.242 and 0.357 respectively) they do not explain the observed difference in behavior. In table 5 we present the key results when estimating our model while controlling for consumers quality concern (top part of the table) and health concern (bottom part of the table). In appendix table A11 we present the complete set of estimated model parameters. The first cell of column 1 presents parameters for the most reputation-concerned consumers who in the questionnaire also indicate that they are among the most quality-concerned while the second cell of column 1 presents parameters for the most reputation-concerned consumers who are among the least concerned about quality. We see that both quality types decrease demand when there is a price discount if they are among the most concerned about reputation. Looking at the first two cells of column 2 we see that for the least reputation-concerned, both quality types increase demand when there is a price discount. Thus controlling for quality does not significantly modify the effect of reputation concern. We see the same reaction pattern when controlling for health concern and conclude that there is no indication that our result is driven by consumers' health or quality concerns.

Table 5: Estimation Results for General MNL model of consumer's milk demand[¤]

	(3)	(4)
	Most reputation-concerned: Estimated parameters (standard deviation)	***Least reputation-concerned:*** Estimated parameters (standard deviation)
Quality Interacted model:		
Most concerned about quality		
Price	-0.074***	-0.055***
	0.013	0.018
Price discount dummy	-0.181**	0.462***
	0.072	0.072
Least concerned about qualiy		
Price	-0.262***	-0.192***
	0.066	0.021
Price discount dummy	-1.173***	0.393***
	0.334	0.102
Number of consumers	114244	
Number of observations	263	
Log likelihood	-89750.285 ***	
Pseudo R	0.032	

Most concerned about health		
Price	-0.078***	-0.106***
	0.013	0.018
Price discount dummy	-0.231***	0.435***
	0.075	0.072
Least concerned about health		
Price	-0.103***	-0.102***
	0.035	0.022
Price discount dummy	-0.337	0.316***
	0.213	0.102
Number of consumers¤	114244	
Number of observations	263	
Log likelihood	-88938.541 ***	
Pseudo R	0.033	

****, **, and * represents significance level at 1%, 5%, and 10% respectively*

[¤]*See appendix table A11 for estimation results without interaction with reputation motives*

Even though time of shopping and quality/health concern cannot explain the observed behavior, it is possible that the most reputation-concerned consumers have other reasons for not buying milk on discount. For example, it may be more crowded at the counter where the discounted goods are placed and the most reputation-concerned consumers may dislike this, or they may not like buying goods on discount for some other reasons which are not related to pro-social reputation (or quality/health or time of shopping), whereas this may not be the case for the consumers we categorize as the least reputation-concerned. Without survey questions specifically addressing each potential confounder, we can of course never completely rule this out. But if this is the case, we would also expect to find the same difference in reactions to price discounts on goods *without* a pro-social characteristic where signalling could not explain the difference in behavior. In table 6, we present estimation results for two goods (canned seafood and Nutella) without distinguishable pro-social characteristics allowing differentiation between good and bad variants of the product. Using weekly purchase data for these goods for the same consumers over the same time period, we have estimated price and price discount effects (added effect of a large price discount) using fixed effect linear regressions (controlling for consumer specific fixed effects).

Table 6: Estimation Results Fixed Effects

	Sea Food	Nuttela
Most concerned about reputation:		
Price	-0.042***	-0.035***
	(0.005)	(0.005)
Price discount dummy	0.086***	0.033
	(0.022)	(0.028)
Least concerned about reputation:		
Price	-0.039***	-0.033***
	(0.006)	(0.005)
Price discount dummy	0.053***	0.070**
	(0.029)	(0.032)
Number of observations	5189	1486
Number of consumers#	245	155
F-test	25.14***	17.72***
R-square	0.126	0.243

****, **, and * represents significance level at 1%, 5%, and 10% respectively*
We use weekly purchase data for both seafood and Nutella. The price discount dummy indicates a price decrease of 15% or greater.
#Out of the 263 consumers that we have in the milk data, only 245 and 155 consumers actually bought seafood and Nuttela respectively during 2007 and 2008.

We see that both groups of consumers react to large discounts (over 15%) on seafood by increasing demand - the most reputation-concerned actually buy more than the least-concerned. For Nutella, the positive reaction to a large discount is smaller and not significant for the most reputation-concerned, but there is no indication from these markets that the most reputation-concerned consumers generally dislike buying goods on discount. We have estimated these models with different definitions of a large discount (10%- 25%) giving the same pattern of results. In appendix table A12, we also present results for alternative models where the dummy indicates consumers' self-reported perception that the purchased good was on discount. These results suggest that in the absence of pro-social characteristics, the most reputation-concerned consumers are more attracted by what they perceive as discounted prices than the least reputation-concerned consumers in both markets.

In conclusion, we find evidence for reverse reactions to price changes from reputation-concerned consumers in the Danish organic milk market. The evidence also suggests that this is driven by reputation signalling since unconcerned consumers do not exhibit this reaction and since there is evidence against likely alternative explanations such as differences in shopping time or quality/health motives or a general dislike of price discounts among the most reputation-concerned consumers.

5. Policy implications

If reputation is important for consumers of goods with pro-social characteristics, it may have implications for policy makers. In the following, we briefly illustrate some possible implications that reputation effects may have for policies based on promotion through subsidization. Our aim is only to illustrate that such implications are potentially important and warrant investigation. We leave an extensive investigation hereof for future work.

A number of countries have subsidized organic food in various ways because organic farming methods that are thought to have positive environmental and health effects compared to conventional farming methods. Here, the 'standard' neo-classical policy recommendation would be

to subsidize all ecological goods proportionally. For example, if there are two types of ecological milk on the market generating the same positive external effects, these should be subsidized by the same amount because any distortion would induce welfare reducing substitution between the two goods without generating an increase in the positive external effect. However, if some consumers exhibit net-crowding, such subsidy differentiation may be an advantage. The reason is that for such consumers, subsidies are welfare reducing since their loss in signalling utility outweighs their gain from reduced prices. Allowing such consumers to continue buying an expensive good variant increases their welfare and saves on subsidy costs. Though distorted subsidies induce less reputation-concerned consumers to make welfare reducing substitutions, the net welfare effect may be positive.

To investigate this we simulate the effects of uniform and differentiated subsidies using a slightly adjusted version of the simulation model developed above. Consumers are assumed to choose between good and bad variants of two close substitutes:

$$\begin{aligned} U^g &= u + v_g - p^g + v^r r^g \\ U^b &= u - p^b + v^r r^b \\ U_a^g &= u_a + v_g - p_a^g + v^r r_a^g \\ U_a^b &= u_a - p_a^b + v^r r_a^b \end{aligned} \tag{18}$$

where U^g and U^b are defined as above, while U_a^g and U_a^b are the corresponding utilities in the alternative market (p_a^g, p_a^b are the alternative good prices and r_a^g and r_a^b are the mean of v^g values for consumers in these markets). The 1,000 consumers are characterized by the same utility function parameters as above for correlated heterogeneous reputation concern[22] and for a given set of prices (p^g, p^b, p_a^g, p_a^b). The model finds the equilibrium distribution of consumers across the four markets by iteration.

[22] Where u_a -values (instead of U_a -values) are uniformly distributed.

The initially good variant market shares (and their sum 37.4%) are indicated in the first column of table 7. We investigate the effect of a uniform subsidy by reducing both good variant prices (p^g and p_a^g) by the same amount until the total good variant market share has increased to 44.4%. The resulting good variant market shares (and their sum) are indicated in column 2 of table 7. We then investigate the effect of a distorted subsidy by only reducing p^g until the total demand for the two good product variants has increased to the same level (where the resulting market shares are indicated in column 3). Thus, both subsidy policies achieve the same increase in total good variant market share (the assumed policy goal) though the distribution over markets differs. However, the welfare costs (total utility of consumers minus total subsidy paid to consumers) are *lower* for the differentiated subsidy as indicated in the bottom row of table 7. The uniform subsidy (of both good variants) reduces welfare compared to the baseline by 1.54%, while the differentiated subsidy (subsidizing only the main products good variant) only reduces welfare by 1.31%. In addition public expenditures on subsidies are lower.

Table 7: Policy Simulation

	Baseline (Before policy)	Uniform subsidy	Distorted subsidy
Share of main product good variant	23.6	29.2	31.22
Share of alternative good variant	13.8	15.2	13.18
Total share of good variants	37.4	44.4	44.4
Normalized social welfare	100	98.46	98.69

The simulation illustrates that if reputation effects are important, the policy implications of the resulting crowding-out effects may be unconventional and the welfare gains from taking them into account may be substantial.

6. Conclusion

In this paper, we incorporate a reputation-signalling model (proposed by Bénabou and Tirole, 2006, for volunteering and charitable giving) into a characteristics model to develop a choice model for consumers who buy products containing pro-social characteristics. We use this model to show that reputation driven reverse reactions to price reductions are possible when reputation-concerned consumers have the option of opting out of the market e.g. by purchasing a close substitute instead.

We also present evidence of such reputation driven reverse price reactions among reputation-concerned consumers in the Danish market for organic milk.

Both our numerical simulations and estimations from the Danish milk market reveal that 'crowding' reactions from reputation-concerned consumers may be masked by 'neo-classical' reactions from less reputation-concerned consumers. Thus, even when aggregate market reactions look 'neoclassical,' a significant segment of consumers may actually be experiencing reputation motivation crowding-out, or even net-crowding out resulting in reverse price reactions. We suspect that reputation motivation crowding may be more than a marginal phenomenon in markets where pro-social characteristics are important. Investigating the importance of reputation motivation crowding in consumer goods markets and the policy implications this may have therefore seems an important agenda for future research.

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APPENDIX For Online Publication

1. Simulation model

Table A1: Simulation Model Parameter values

Parameter	Values for model (9) with heterogeneous reputation concern	Values for model (18) with heterogeneous reputation concern	Description
U_a	Uniform [-6,6]	-	Utility of alternative product*
u_a	-	Uniform [-5,5]	Private utility of alternative product
v^g	50% $v^g = 0$, 50% Uniform]0,2]	50% $v^g = 0$, 50% Uniform]0,2]	Intrinsic pro-social utility
v^r	50% $v^r = 0$, 50% Uniform]0,1]	50% $v^r = 0$, 50% Uniform]0,1]	Reputation concern
p^g	2	2.5	Price of good variant in the choice market
p^b	1	1	Price of bad variant in the choice market
p_a^g	-	2.5	Price of good variant in the alternative market
p_a^b	-	1	Price of bad variant in the alternative market
	Equilibrium values of reputation gains		
Correlated v^g *and* v^r			
r^g	1.259(1.140)¤		
r^b	0.012(0.013)¤		
Uncorrelated v^g *and* v^r			
r^g	0.649(0.721)¤		
r^b	0.066(0.056)¤		

* U_a *values are uniformly distributed around the initial* U^g *values (with* r^g *= 1), i.e. so that* U_a *-* U^g *initially follows the indicated distribution and is independent of other utility function parameters.*

¤ *The figures in parenthesis are equilibrium values when there is no outside option.*

2. The Danish Organic Milk Dataset

Table A2: Descriptive statistics sample of 263 organic milk consumers

Variable name	Mean	Std. Dev.
Dependent variable		
Type	2.669	1.477
Volume	2.190	1.634
Explanatory Variables		
Organic Prices:		
Semi	7.739	0.710
Skim	6.968	0.749
Mini	7.324	0.823
Conventional Prices		
Semi	6.124	0.727
Skim	5.414	0.862
Mini	5.244	0.616
Socio-demographic variables	*Proportion in the sample(%)*	
Age<30	3.81	
30≤age<60	57.85	
Age≥60	38.34	
No education	12.11	
Vocational and short	52.69	
Medium and long education	35.20	
Copenhagen	35.65	
Zealand	19.06	
South Denmark	18.16	
Mid-Jutland	20.18	
North Jutland	6.95	
Income<250000	25.56	
Income:250000-400000	34.75	
Income≥400000	39.69	
Female	80.94	
Male	19.06	
Most concerned about reputation	56.95	
Least concerned about reputation	43.05	
Number of consumers	263	
sample size	20623	

Table A3: Comparing consumption (in milliliters) in weeks with price discounts and the weeks before

	Average organic consumption during:		
	Weeks before price discount*	Price discount weeks**	Difference
Most concerned about reputation	7410.93	6963.56	-6.0%
Least concerned about reputation	7580.38	8519.15	12.4%
Total	7495.655	7741.355	3.3%
Number of consumers***	134	134	
Number of weeks	69	69	

** Average volume of discounted organic milk purchased per consumer in weeks before the price is discounted to or below conventional price.** Average volume of discounted organic milk purchased per consumer in weeks where price is discounted to or below conventional price of the same type of milk. *** Of the 263 consumers in our dataset 134 buy milk both during a discount week and the week before at least once during the two year period.*

3. General MNL model variants

When a consumer buys all her milk in one store, she faces these prices for all 'no purchase' choices. When a consumer buys milk in several different stores during the week, it is not clear what the relevant price alternatives are for no purchase observations. The main model (first column) is estimated on data for weeks where a consumer purchases all milk in one store avoiding this issue (this is the case in 64% of our week observations). The next two models include weeks where consumers have purchased milk in more than one store under alternative no purchase pricing assumptions. The second column presents results of the 'latest store' model where no purchases in those weeks are associated with prices observed in the latest store where milk is bought during the week. The third column assumes that 'no purchases' are associated with average prices over all stores where milk is bought during the week (weighted by purchase volume). In the fourth column, we present a model with an alternative specification of the discount to conventional effect measuring the distance between the organic and conventional price as *exp(-max(organic price – conventional price,0))*. Finally, in column five, we estimated the base model without the socio-demographic control variables where we can include more panel households. In all these models, we assume a consumer can buy up to 10 liters of milk per week (one or more of the milk types in one or more stores). The difference between what consumers actually bought and 10 liters goes to 'no purchase' option. This maximum purchase holds for 99.5% of the observations. We checked the robustness of this assumption and all the model results are robust to a higher or lower assumed maximum weekly milk consumption.

Table A4: Estimation Results for the General MultiNomialLogit (MNL) models of milk consumers behavior

	1 (Main)	2 (Latest store)	3 (Weighted)	4 (Exp-max)	5 (Reduced)
N	119244	150054	150054	119244	124431
Number of consumers	263	263	263	263	283
Log likelihood	-92859.297***	-128118.55***	-128104.55***	-92766.506***	-100045.51***
Pseudo R^2	0.028	0.027	0.027	0.029	0.004
Most concerned about reputation					
Price	-0.078***	-0.105***	-0.109***	-0.139***	-0.053***
	(0.012)	(0.010)	(0.010)	(0.013)	(0.012)
Price discount dummy	-0.244***	-0.240***	-0.100*	-	-0.284***
	(0.070)	(0.056)	(0.056)		(0.068)
Alternative price discount measure	-			-0.786*** (0.058)	-
Least concerned about reputation					
Price	-0.103***	-0.085***	-0.089***	-0.085***	-0.071***
	(0.013)	(0.012)	(0.012)	(0.014)	(0.013)
Price discount dummy	0.359***	0.294***	0.375***	-	0.471***
	(0.058)	(0.052)	(0.052)		(0.055)
Alternative price discount measure	-			0.349*** (0.054)	-
Reputation concern					
Skim	-0.251**	0.108	0.106	0.577***	-0.189
	(0.129)	(0.109)	(0.111)	(0.146)	(0.123)
Mini	0.017	0.386***	0.385***	0.761***	0.016
	(0.135)	(0.114)	(0.116)	0.149)	(0.129)
Semi	-0.527***	-0.059	-0.060	0.350**	-0.521***
	(0.144)	(0.123)	(0.125)	(0.162)	(0.138)
Socio-demographics Skim					
Age					
Age<30					
Age:30-60	-0.594***	-0.395***	-0.397***	-0.565***	
	(0.048)	(0.040)	(0.040)	(0.048)	
Age≥60	-0.933***	-0.861***	-0.863***	-0.917***	
	(0.048)	(0.042)	(0.042)	(0.048)	
Education					
No education					

Continued	1	2	3	4	5
	(Main)	(Latest store)	(Weighted)	(Exp-max)	(Reduced)
Vocational and	0.376***	0.269***	0.269***	0.356***	
Short education	(0.035)	(0.029)	(0.029)	(0.035)	
Medium and	0.215***	0.124***	0.125***	0.195***	
long education	(0.038)	(0.031)	(0.031)	(0.038)	
Region					
Copenhagen area					
Zealand	-0.078**	0.121***	0.122***	-0.057*	
	(0.031)	(0.026)	(0.026)	(0.031)	
South Denmark	0.102***	0.132***	0.132***	0.110***	
	(0.030)	(0.027)	(0.027)	(0.030)	
Mid-Jutland	0.357***	0.562***	0.564***	0.368***	
	(0.027)	(0.023)	(0.023)	(0.027)	
North Jutland	-0.437***	-0.139***	-0.137***	-0.444***	
	(0.050)	(0.039)	(0.039)	(0.050)	
Income(annual income in Danish Kroner)					
Income<250,000					
Income250000-400000	-0.157***	-0.100***	-0.101***	-0.143***	
	(0.030)	(0.027)	(0.027)	(0.030)	
Income≥400,000	0.286***	0.319***	0.318***	0.284***	
	(0.031)	(0.027)	(0.027)	(0.032)	
Gender					
Male		-0.361***	-0.361***		
Female	-0.265***	(0.024)	(0.024)	-0.268***	
	(0.028)			(0.028)	
Mini organic milk		-	-		
Age					
Age<30					
Age:30-60	0.537***	0.183***	0.182***	0.517***	
	(0.071)	(0.048)	(0.048)	(0.071)	
Age≥60	0.515***	0.173***	0.172***	0.492***	
	(0.072)	(0.049)	(0.049)	(0.072)	
Education					
No education					
Vocational and	-0.014	0.031	0.032	-0.015	
Short education	(0.032)	(0.027)	(0.027)	(0.032)	
Medium and	-0.162***	-0.084***	-0.083***	-0.167***	
long education	(0.035)	(0.029)	(0.029)	(0.035)	
Region					
Copenhagen area					
Zealand	0.203***	0.148***	0.149***	0.210***	
	(0.028)	(0.023)	(0.023)	(0.028)	

Continued	1	2	3	4	5
	(Main)	(Latest store)	(Weighted)	(Exp-max)	(Reduced)
South Denmark	0.109***	-0.009	-0.009	0.109***	
	(0.029)	(0.025)	(0.025)	(0.029)	
Mid-Jutland	0.008	0.026	0.027	0.008	
	(0.029)	(0.024)	(0.024)	(0.029)	
North Jutland	0.216***	0.280***	0.281***	0.213***	
	(0.040)	(0.032)	(0.032)	(0.040)	
Income(annual income in Danish Kroner)					
Income<250,000					
Income:250000-400000	0.462***	0.555***	0.555***	0.460***	
	(0.030)	(0.026)	(0.026)	(0.030)	
Income≥400,000	0.722***	0.799***	0.800***	0.722***	
	(0.033)	(0.028)	(0.028)	(0.033)	
Gender					
Male					
Female	-0.220***	-0.257***	-0.256***	-0.217***	
	(0.026)	(0.022)	(0.022)	(0.026)	
Semi organic milk					
Age					
Age<30					
Age:30-60	0.957***	0.584***	0.583***	0.960***	
	(0.114)	(0.077)	(0.077)	(0.114)	
Age≥60	0.464***	0.088	0.086	0.469***	
	(0.114)	(0.078)	(0.078)	(0.114)	
Education					
No education					
Vocational and	-1.684***	-1.122***	-1.122***	-1.389***	
Short education	(0.039)	(0.034)	(0.034)	(0.039)	
Medium and	-0.936***	-0.665***	-0.664***	-0.948***	
long education	(0.040)	(0.035)	(0.035)	(0.040)	
Region					
Copenhagen area					
Zealand	0.202	-0.054	-0.054	0.199***	
	(0.040)	(0.034)	(0.034)	(0.040)	
South Denmark	-0.458***	-0.465***	-0.466***	-0.458***	
	(0.045)	(0.038)	(0.038)	(0.045)	
Mid-Jutland	-0.473***	-0.442***	-0.440***	-0.48***	
	(0.043)	(0.034)	(0.034)	(0.043)	
North Jutland	-0.417***	-0.336***	-0.334***	-0.419***	
	(0.057)	(0.047)	(0.047)	(0.057)	

Continued	1 (Main)	2 (Latest store)	3 (Weighted)	4 (Exp-max)	5 (Reduced)
Income(annual income in Danish Kroner)					
Income<250,000					
Income:250000-400000	0.129***	0.117***	0.115***	0.131***	
	(0.046)	(0.039)	(0.039)	(0.046)	
Income≥400,000	0.722***	0.604***	0.604***	0.718***	
	(0.046)	(0.038)	(0.038)	(0.046)	
Gender					
Male					
Female	0.027	0.204***	0.205***	0.024	
	(0.035)	(0.028)	(0.028)	(0.035)	
Constant					
Skim	-0.992***	-1.175***	-1.145***	-1.222***	
	(0.109)	(0.095)	(0.096)	(0.121)	
Mini	-2.352***	-2.069***	-2.038***	-2.516***	
	(0.125)	(0.101)	(0.102)	(0.133)	
Semi	-1.884***	-1.671***	-1.640***	-2.092***	
	(0.157)	(0.122)	(0.124)	(0.166)	

****, **, and * represent significance level at 1%, 5%, and 10% respectively*

4. Conditional MNL model variants

Table 5 below presents results of the conditional MNL model corresponding to the main model above and variants hereof. The main model is estimated on data for weeks where a consumer purchases all milk in one store. The second column presents results when weeks where milk is bought in more than one store are also included (since there is no 'no purchase' option we do not have to make any pricing assumption). In the third column, we present a model with the same alternative specification of the discount to conventional effect as used in the general model. Finally, in column four, we estimated the base model without the socio-demographic control variables where we can include more panel households.

Table A5: Estimation Results for the conditional MultiNomialLogit (MNL) models of milk consumers' behavior

	1 (Main)	2 (All weeks)	3 (Exp-max)	4 (Reduced)
N	29895	44242	29895	31480
Number of Consumers	263	263	263	283
Log likelihood	-29488.977***	-43976.639***	-29265.975***	-32753.079***
Pseudo R^2	0.063	0.056	0.070	0.012
Most concerned about reputation				
Price	-0.368***	-0.368***	-0.499***	-0.298***
	(0.021)	(0.017)	(0.022)	(0.019)
Price discount dummy	-0.562***	-0.467***	-	-0.589***
	(0.086)	(0.067)		(0.083)
Alternative price discount measure			-1.622*** (0.081)	
Least concerned about reputation				
Price	-0.078***	-0.042**	-0.021	-0.063***
	(0.023)	(0.019)	(0.024)	(0.022)
Price discount dummy	0.592***	0.358***	-	0.749***
	(0.079)	(0.067)		(0.072)
Alternative price discount measure			0.832*** (0.078)	
Reputation concern				
Skim	1.713***	1.972***	3.634***	1.455
	(0.218)	(0.179)	(0.242	(0.204)
Mini				
Semi	1.673***	1.992***	3.72***	1.262***
	(0.243)	(0.2)	(0.267)	(0.228)
Socio-demographics				
Skim organic milk				
Age				
Age<30				
Age=(30,60)	-1.241***	-0.637***	-1.234***	
	(0.08)	(0.057)	(0.081)	
Age≥60	-1.504***	-1.086***	-1.52***	
	(0.082)	(0.06)	(0.083)	
Education				
No education				
Vocational and Short education	0.413***	0.251***	0.39***	
	(0.045)	(0.037)	(0.046)	

Continued	1	2	3	4
	(Main)	(All weeks)	(Exp-max)	(Reduced)
Medium and	0.335***	0.164***	0.314***	
long education	(0.049)	(0.04)	(0.049)	
Region				
Copenhagen area				
Zealand	-0.182***	0.086***	-0.137***	
	(0.04)	(0.032)	(0.04)	
South Denmark	0.104***	0.232***	0.114***	
	(0.039)	(0.034)	(0.039)	
Mid-Jutland	0.529***	0.69***	0.556***	
	(0.037)	(0.03)	(0.037)	
North Jutland	-0.584***	-0.288***	-0.594***	
	(0.061)	(0.046)	(0.062)	
Income(annual income in Danish Kroner)				
Income<250,000				
Income=(250000,400000)	-0.577***	-0.648***	-0.573***	
	(0.041)	(0.035)	(0.041)	
Income≥400,000	-0.491***	-0.533***	-0.491***	
	(0.043)	(0.036)	(0.044)	
Gender				
Male				
Female	0.028	-0.046	0.017	
	(0.037)	(0.031)	(0.037)	
Mini organic milk	-	-	-	
(base outcome)				
Semi organic milk				
Age				
Age<30				
Age=(30,60)	0.369***	0.351***	0.325**	
	(0.132)	(0.088)	(0.132)	
Age≥60	-0.074	-0.17*	-0.118	
	(0.133)	(0.091)	(0.134)	
Education				
No education				
Vocational and	-1.387***	-1.23***	-1.403***	
Short education	(0.048)	(0.041)	(0.048)	
Medium and	-0.757***	-0.54***	-0.76***	
long education	(0.05)	(0.042)	(0.05)	
Region				
Copenhagen area				
Zealand	-0.006	-0.259	-0.011	
	(0.047)	(0.039)	(0.047)	

Continued	1	2	3	4
	(Main)	(All weeks)	(Exp-max)	(Reduced)
South Denmark	-0.544***	-0.482***	-0.557***	
	(0.05)	(0.042)	(0.05)	
Mid-Jutland	-0.473***	-0.5***	-0.48***	
	(0.05)	(0.04)	(0.05)	
North Jutland	-0.508***	-0.581***	-0.498***	
	(0.067)	(0.054)	(0.067)	
Income(annual income in Danish Kroner)				
Income<250,000				
Income=(250000,400000)	-0.262***	-0.449***	-0.264***	
	(0.053)	(0.044)	(0.053)	
Income≥400,000	-0.062	-0.318***	-0.065	
	(0.054)	(0.043)	(0.054)	
Gender				
Male				
Female	0.441***	0.677***	0.432***	
	(0.043)	(0.034)	(0.043)	
Constant				
Skim	1.921***	1.197***	1.315***	0.448***
	(0.183)	(0.151)	(0.2)	(0.153)
Mini				
Semi	1.048***	0.856***	0.463**	0.011
	(0.226)	(0.178)	(0.241)	(0.17)

****, **, and * represent significance level at 1%, 5%, and 10% respectively*

5 Data mining Models

We estimated a data-mining version of the main general MNL model allowing the parameter for prices and shocks to be different and including all other price and price discount variables in addition to own price and price discount variables (Table A6). We then jointly test restrictions on the signs of all these parameters reflecting 'neoclassical' price reactions and 'reversed' price reactions for the two types of consumers.

Table A6: Estimation Results for the Unrestricted Model

	Organic skim	Organic Mini	Organic Semi
Most concerned about reputation			
Price			
Skim	-0.040	0.043	-0.039
	(0.038)	(0.034)	(0.056)
Mini	-0.251***	-0.009	0.099*
	(0.036)	(0.032)	(0.052)
Semi	0.133***	0.143***	-0.241***
	(0.027)	(0.025)	(0.043)
Price discount dummy			
Skim	-0.411***	0.354***	-0.513***
	(0.100)	(0.076)	(0.155)
Mini	0.205	0.132	0.778***
	(0.148)	(0.158)	(0.205)
Semi	0.322***	0.225***	-0.602***
	(0.080)	(0.074)	(0.142)
Least concerned about reputation			
Price			
Skim	-0.133***	-0.110***	0.170***
	(0.039)	(0.041)	(0.050)
Mini	0.109***	-0.092**	0.085*
	(0.036)	(0.038)	(0.046)
Semi	0.054*	0.142***	-0.302***
	(0.029)	(0.030)	(0.037)
Price discount dummy			
Skim	0.451***	-0.293**	-0.226*
	(0.091)	(0.119)	(0.137)
Mini	-0.389*	-0.219	0.344
	(0.209)	(0.204)	(0.216)
Semi	-0.041	0.300***	0.415***
	(0.086)	(0.085)	(0.087)
Reputation concern	1.288***	-1.561***	0.528
	(0.242)	(0.237)	(0.344)
Constant	-2.339***	-1.759***	-2.101***
	(0.175)	(0.181)	(0.229)

Continued	Organic skim	Organic Mini	Organic Semi
N	124431		
Number of consumers	283		
Log likelihood	-99778.370***		
Pseudo R^2	0.005		

****, **, and * represent significance level at 1%, 5%, and 10% respectively*

We present likelihood ratio (LR) tests of the two sets of restrictions (Neoclassical and reversed) against the unconstrained model[23] for the most and least reputation-concerned consumers separately and jointly. As can be seen from Table A7, we can clearly reject the neoclassical restrictions and accept the 'reversed' restrictions for the most reputation-concerned, while the reverse holds for the least reputation-concerned. From table A8 we see that the joint test of neoclassical restrictions for both groups is rejected, while the joint test of neoclassical for the least reputation-concerned and reversed for the most concerned is accepted.

Table A7. LR tests of restrictions for most and least concerned about reputation separately

Restriction	Most concerned about reputation	Least concerned about Reputation
Neoclassical:		
Own price effects >0	81.2 (0.000)	15.48(0.079)
Cross price effects <0		
Reversed:		
Own price effects <0	13.112(0.158)	57.24(0.000)
Cross price effects >0		

Note: The LR values are compared with $\chi^2_{0.05,9} = 16.919$

[23] There has been a debate on testing inequality constraints referenced in Schoot et al. (2010). This paper finds that while test values for inequality constraints in small samples do not follow the chi-distribution they do so approximately for large samples. Since our sample is very large, we use the standard chi-test.

6. Robustness Checks

Here we present general MNL model estimation results from our robustness checks. Column one presents estimation results after restricting to purchase events early in the day (where the likelihood of rationing is low). Columns 2-5 present estimation results for all purchase events. In the second column, we present estimation results for most and least concerned about quality while column 3 presents these estimation results for most and least concerned about health. Alternatively, in the fourth and fifth columns, we present estimation results with interactions. In the fourth column, we present estimation results with interaction between reputation and health concerns while column 5 presents these estimation results with interaction between reputation and quality.

Table A11: Estimation Results for General MNL model of consumer's milk demand

	1 (Early shopping)	2 (Quality)	3 (Health)	4 ReputationXhelth	5 ReputationXquality
N	59649	114244	114244	114244	114244
Number of consumers	256	263	263	263	263
Log likelihood	-47935.991***	-89324.838 ***	-89230.217 ***	-88938.541 ***	-89750.285 ***
Pseudo R^2	0.033	0.029	0.030	0.033	0.032
Most concerned about reputation					
Price	-0.102***	-0.094***	-0.075***		
	(0.017)	(0.011)	(0.010)		
Price discount dummy	-0.164*	0.105**	0.119**		
	(0.090)	(0.051)	(0.050)		
Least concerned about reputation					
Price	-0.088***	-0.103***	-0.194***		
	(0.018)	(0.019)	(0.020)		
Price discount dummy	0.351***	0.153*	0.104		
	(0.089)	(0.091)	(0.095)		
¤*Most concerned about both reputation and health(quality)*					
Price				-0.078***	-0.074***
				0.013	0.013
Price discount dummy				-0.231***	-0.181**
				0.075	0.072
¤*Most concerned about reputation and least concerned about health(quality)*					
Price				-0.103***	-0.262***
				0.035	0.066
Price discount dummy				-0.337	-1.173***
				0.213	0.334
¤*Least concerned about both reputation and health (quality)*					
Price				-0.102***	-0.192***
				0.022	0.021
Price discount dummy				0.316***	0.393***
				0.102	0.102
¤*Least concerned about reputation and most concerned about health (quality)*					
Price				-0.106***	-0.055***
				0.018	0.018
Price discount dummy				0.435***	0.462***
				0.072	0.072

	1 (Early shopping)	2 (Quality)	3 (Health)	4 ReputationXhelth	5 ReputationXquality
Reputation concern					
Skim	0.080			-0.563*	-0.052
	(0.178)			0.291	0.489
Mini	0.204			-0.039	1.118**
	(0.186)			0.307	0.510
Semi	-0.073			0.394	-0.024
	(0.200)			0.328	0.540
Health concern					
Skim			-1.200***		-1.452***
			(0.161)		0.198
Mini			-0.759***		-0.926***
			(0.169)		0.207
Semi			-1.377***		-1.484***
			(0.181)		0.223
Quality concern					
Skim		-0.315**		-0.454*	
		(0.151)		0.200	
Mini		0.110		-0.029	
		(0.158)		0.210	
Semi		-0.293*		0.214	
		(0.170)		0.225	
RuputationXhealthconcern					
Skim					0.252
					0.513
Mini					-0.711
					0.535
Semi					-0.039
					0.566
RuputationXquality concern					
Skim				0.481	
				0.330	
Mini				0.171	
				0.347	
Semi				-1.125***	
				0.371	
Socio-demographics Skim					
Age					
Age<30					
Age:30-60	-0.827***	-0.494***	-0.598***	-0.551***	-0.641***
	(0.075)	(0.049)	(0.048)	0.049	0.048

	1 (Early shopping)	2 (Quality)	3 (Health)	4 ReputationXhelth	5 ReputationXquality
Age≥60	-1.246***	-0.748***	-0.848***	-0.815***	-0.907***
	(0.075)	(0.050)	(0.048)	0.050	0.049
Education					
No education					
Vocational and	0.363***	0.365***	0.408***	0.356***	0.425***
Short education	(0.048)	(0.035)	(0.036)	0.036	0.036
Medium and	0.261***	0.208***	0.242***	0.211***	0.259***
long education	(0.052)	(0.038)	(0.038)	0.038	0.038
Region					
Copenhagen area					
Zealand	-0.103**	-0.090***	-0.031	-0.054*	-0.025
	(0.045)	(0.032)	(0.032)	0.032	0.032
South Denmark	0.128***	0.082***	0.100***	0.056*	0.048
	(0.040)	(0.030)	(0.030)	0.030	0.030
Mid-Jutland	0.306***	0.401***	0.405***	0.372***	0.384***
	(0.038)	(0.027)	(0.027)	0.027	0.027
North Jutland	-0.426***	-0.410***	-0.342***	-0.400***	-0.340***
	(0.068)	(0.051)	(0.052)	0.051	0.051
Income(annual income in Danish Kroner)					
Income<250,000					
Income250000-400000	-0.283***	-0.144***	-0.132***	-0.177***	-0.152***
	(0.041)	(0.030)	(0.031)	0.031	0.031
Income≥400,000	0.251***	0.331***	0.355***	0.289***	0.306***
	(0.045)	(0.032)	(0.032)	0.032	0.032
Gender					
Male					
Female	-0.211***	-0.264***	-0.265***	-0.253***	-0.262***
	(0.037)	(0.028)	(0.028)	0.029	0.028
Mini organic milk					
Age					
Age<30					
Age:30-60	0.244**	0.497***	0.570***	0.530***	0.598***
	(0.107)	(0.072)	(0.071)	0.072	0.072
Age≥60	0.274**	0.356***	0.433***	0.383***	0.473***
	(0.108)	(0.073)	(0.072)	0.073	0.072
Education					
No education					
Vocational and	-0.028	0.017	-0.009	-0.020	-0.047
Short education	(0.043)	(0.032)	(0.033)	0.033	0.032
Medium and	-0.026	-0.187***	-0.225***	-0.195***	-0.230***
long education	(0.047)	(0.036)	(0.036)	0.036	0.035

	1 (Early shopping)	2 (Quality)	3 (Health)	4 ReputationXhelth	5 ReputationXquality
Region					
Copenhagen area					
Zealand	0.267***	0.222***	0.186***	0.206***	0.164***
	(0.038)	(0.029)	(0.029)	0.029	0.029
South Denmark	0.012	0.072**	0.037***	0.129***	0.157***
	(0.039)	(0.030)	(0.030)	0.031	0.030
Mid-Jutland	-0.071*	-0.082***	-0.094***	-0.063**	-0.051*
	(0.041)	(0.030)	(0.030)	0.030	0.030
North Jutland	0.246***	0.156***	0.125***	0.200***	0.146***
	(0.055)	(0.042)	(0.042)	0.042	0.042
Income(annual income in Danish Kroner)					
Income<250,000					
Income:250000-400000	0.629***	0.372***	0.359***	0.385***	0.392***
	(0.040)	(0.031)	(0.031)	0.032	0.031
Income≥400,000	0.876***	0.672***	0.666***	0.666***	0.707***
	(0.045)	(0.034)	(0.034)	0.034	0.034
Gender					
Male					
Female	-0.222***	-0.319***	-0.328***	-0.309***	-0.305***
	(0.035)	(0.029)	(0.029)	0.029	0.028
Semi organic milk					
Age					
Age<30					
Age:30-60	1.638***	1.158***	0.975***	1.296***	0.907***
	(0.248)	(0.115)	(0.114)	0.119	0.114
Age≥60	0.793***	0.747***	0.581***	0.872***	0.519***
	(0.249)	(0.117)	(0.114)	0.120	0.114
Education					
No education					
Vocational and	-1.146***	-1.436***	-1.379***	-1.405***	-1.347***
Short education	(0.055)	(0.039)	(0.039)	0.040	0.040
Medium and	-1.000***	-0.968***	-0.919***	-1.003***	-0.934***
long education	(0.060)	(0.041)	(0.041)	0.042	0.041
Region					
Copenhagen area					
Zealand	-0.328***	0.145***	0.228***	0.104**	0.206***
	(0.061)	(0.040)	(0.041)	0.041	0.041
South Denmark	-0.683***	-0.431***	-0.408***	-0.497***	-0.530***
	(0.061)	(0.045)	(0.045)	0.046	0.046
Mid-Jutland	-0.502***	-0.491***	-0.478***	-0.544***	-0.533***
	(0.058)	(0.043)	(0.043)	0.044	0.044

	1 (Early shopping)	2 (Quality)	3 (Health)	4 ReputationXhelth	5 ReputationXquality
North Jutland	-0.351***	-0.370***	-0.271***	-0.507***	-0.365***
	(0.075)	(0.057)	(0.057)	0.058	0.058
Income(annual income in Danish Kroner)					
Income<250,000					
Income:250000-400000	0.060	0.165***	0.204***	0.104**	0.142***
	(0.065)	(0.047)	(0.047)	0.047	0.047
Income≥400,000	0.735***	0.802***	0.856***	0.747***	0.805***
	(0.066)	(0.047)	(0.048)	0.047	0.047
Gender					
Male					
Female	0.034	0.012	0.021	0.004	-0.012
	(0.048)	(0.036)	(0.036)	0.036	0.036
Constant					
Skim	-0.705***	-0.973***	-0.201***	-0.723***	-0.060
	(0.153)	(0.137)	(0.153)	0.163	0.162
Mini	-2.146***	-2.231***	-1.543***	-2.249***	-1.764***
	(0.177)	(0.154)	(0.169)	0.179	0.177
Semi	-2.438***	-2.095***	-1.141***	-2.275***	-0.922***
	(0.290)	(0.183)	(0.197)	0.211	0.207

****, **, and * represent significance level at 1%, 5%, and 10% respectively*

¤ *Health concern is used for the results in the 4th column while quality concern is used in the 5th column.*

Table A8: LR tests of restrictions for most and least concerned about reputation jointly

Most concerned about Reputation	Least concerned about reputation	
Neoclassical: Own price effects >0 Cross price effects <0	Neoclassical: Own price effects >0 Cross price effects <0	115(0.000)
Reversed Own price effects <0 Cross price effects >0	*Neoclassical* Own price effects >0 Cross price effects <0	28.592(0.054)

Note: The LR values are compared with $\chi^2_{0.05,18} = 28.869$

Below we present corresponding restriction test in a corresponding data-mining model for the general latest store model. We find the same pattern of restriction test results.

Table A9. LR tests of restrictions for most and least concerned about reputation separately

Restriction	Most reputation-concerned consumers	Least reputation-concerned consumers
Own price effects >0 Cross price effects <0	55.34(0.000)*	6.3(0.710)
Own price effects <0 Cross price effects >0	15.04(0.090)	101(0.0000)

**The figures in brackets are Prob > chi²*

Note: The LR values are compared with $\chi^2_{0.05,9} = 16.919$

Table A10: LR tests of restrictions for most and least concerned about reputation jointly

Model	Restrictions		LR value	*Prob>chi²*
Neoclassical	All: Own price effects >0 Cross price effects <0		108.46	0.000
Crowding out	*Most reputation-Concerned:* Own price effects <0 Cross price effects >0	*Least reputation-Concerned:* Own price effects >0 Cross price effects <0	22.84	0.197

Note: The LR values are compared with $\chi^2_{0.05,18} = 28.869$

7 Alternative price discount specification for seafood and Nuttela

The price discount dummy indicates a self-reported indicator where consumers report whether there was discount or not during the shopping day. Such price discounts account for an average price reduction of 33.5% for seafood and 25.66% for Nuttela.

Table A12: Estimation Results Fixed Effects

	Seafood	Nuttela
Most concerned about reputation:		
Price	-0.034***	-0.034***
	(0.002)	(0.003)
Perceived price discount dummy	0.225***	0.077***
	(0.018)	(0.025)
Least concerned about reputation:		
Price	-0.027***	-0.031***
	(0.002)	(0.002)
Perceived price discount dummy	0.173***	0.042**
	(0.022)	(0.020)
Constant	0.773***	0.439***
	(0.045)	(0.050)
N	5821	1606
Number of consumers#	245	155
R-square	0.370	0.515

****, **, and * represent significance level at 1%, 5%, and 10% respectively*
of the 263 consumers only 245 and 155 purchase the respective goods.